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Enhancing tuberculosis detection and treatment outcomes among nomadic pastoralists in Nigeria through community engagement and empowerment: A mixed-methods study

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Abstract

Background: Tuberculosis (TB) remains a significant public health challenge in Nigeria, particularly among nomadic pastoralist populations who face barriers such as geographical isolation, cultural differences, and mobility. These factors contribute to low case detection and poor treatment outcomes. This study evaluated a community-based, culturally adapted intervention aimed at improving TB case detection, treatment adherence, and community empowerment in Adamawa State, Nigeria.

Methods: A mixed-methods approach was employed across three LGAs from July 2023 to December 2024. Quantitative data from routine health records assessed changes in case notifications and treatment outcomes; qualitative data from focus groups and interviews explored community perceptions and barriers. The intervention included culturally tailored education, training of pastoralist TB champions, and empowerment activities fostering local ownership.

Results: The intervention resulted in a 72% increase in TB case notifications (from 22% to 38%; $p<0.01$) and improved treatment success to 94% (from 86%; $p<0.05$). Qualitative findings indicated high levels of accurate TB knowledge (78%), reduced stigma, and increased community ownership. Community volunteers played a pivotal role in bridging access gaps and fostering trust.

Conclusions: Community engagement and empowerment strategies significantly improved TB detection and treatment among nomadic pastoralists. Scaling such approaches could be vital in Nigeria's efforts to address TB among marginalized populations.

Keywords: Tuberculosis; Nomadic; community; empowerment; Nigeria

1. Introduction

Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, continues to be a major global public health challenge, accounting for an estimated 10 million new cases and 1.5 million deaths worldwide in 2021 (World Health Organization [WHO], 2022). Despite significant progress in TB control over the past decades, Nigeria remains among the top 30 countries burdened by the disease, with an estimated incidence rate of 219 cases per 100,000 population (WHO, 2022).

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The high burden is compounded by persistent gaps in case detection and treatment, which hinder efforts to reduce transmission and achieve elimination goals.

In Nigeria, particularly among marginalized groups such as nomadic pastoralists, TB case detection remains suboptimal. These populations are estimated to number around 20 million individuals across the country, predominantly residing in remote, semi-arid regions with limited access to formal health services (National Bureau of Statistics [NBS], 2018). Pastoralist communities often lead highly mobile lifestyles, moving seasonally in search of grazing lands, which complicates consistent healthcare delivery and follow-up. Their cultural beliefs, language barriers, and socioeconomic marginalization further hinder engagement with health systems, leading to delayed diagnosis, poor adherence to treatment, and ongoing transmission within communities (Yusuf et al., 2019; Oche et al., 2021).

Traditional health services, primarily designed for sedentary populations, often fail to adequately reach and serve these mobile groups. This gap underscores the urgent need for innovative, culturally sensitive strategies that are tailored to the unique contexts of nomadic populations. Such approaches should involve active community participation, leverage local leadership, and address social determinants influencing health behaviors.

Global evidence supports the effectiveness of community-led interventions, particularly those involving trained community health workers (CHWs) and culturally adapted health education, in improving TB case detection and treatment outcomes among underserved populations (Lönnroth et al., 2018; Datiko et al., 2019). For example, studies in Ethiopia and India have demonstrated that deploying community-based TB screening and treatment support significantly increases detection rates and adherence, especially in remote or marginalized settings. In Nigeria, integrating community volunteers into TB control efforts has shown promising results, including improved case notification and treatment completion rates (NTP Nigeria, 2020). However, tailored interventions specifically designed for the nomadic and highly mobile populations remain limited, highlighting a critical gap in current strategies.

In light of these challenges and evidence, this study aimed to evaluate the impact of a community-based, culturally adapted intervention on TB detection and treatment adherence among nomadic pastoralists in Adamawa State, Nigeria. The intervention was designed to promote community engagement, foster local ownership of TB control activities, and strengthen health system responsiveness—principles aligned with global best practices for reaching hard-to-access populations and ultimately reducing TB burden in Nigeria.

This study aimed to evaluate the impact of a community-based, culturally adapted intervention designed to improve TB detection and treatment adherence among nomadic pastoralists in Adamawa State, Nigeria. The intervention emphasized community engagement, empowerment, and health system strengthening, aligning with global best practices.

2. Methods

2.1. Study Design

This study employed a mixed-methods approach, combining quantitative analysis of routine program data with qualitative explorations to assess the impact of a community-based, culturally adapted intervention on TB detection and treatment adherence among nomadic pastoralists in Adamawa State, Nigeria. This design allowed for triangulation of data, providing both measurable outcomes and contextual understanding of community perceptions and barriers.

2.2. Study Setting

The study was conducted in Adamawa State, situated in northeastern Nigeria, with an estimated population of over 6.2 million people (National Population Commission [NPC], 2006). The state is characterized by a mix of sedentary agricultural communities and highly mobile pastoralist groups, predominantly Fulani and Hausa-Fulani, who migrate seasonally across vast semi-arid plains in search of grazing land and water sources. These pastoralists often live in remote, semi-permanent settlements or move continuously across LGAs, which complicates consistent healthcare delivery (Fadul et al., 2017). The study focused on three LGAs—Girei, Mubi North, and Demsa—selected due to their high density of pastoralist populations, logistical challenges, and existing gaps in TB service delivery.

2.3. Quantitative Methods

2.3.1. Data Collection

Routine TB program data were extracted monthly from the National Tuberculosis and Leprosy Control Program (NTBLCP) reporting system and facility registers. Key indicators included:

- Number and proportion of TB cases notified
- Number of patients initiated on treatment
- Treatment adherence rates
- Treatment success rates (cure and completion)
- Default and lost-to-follow-up rates

Data collection covered January 2022 to December 2024, partitioned into pre-intervention (January 2022 – June 2023) and post-intervention (July 2023 – December 2024) periods.

2.3.2. Analysis

An interrupted time-series analysis (ITSA) was employed to evaluate the intervention's impact over time. This statistical method assesses changes in level and trend of outcomes before and after the implementation, controlling for underlying secular trends and seasonality.

The analysis involved: Plotting monthly data points, fitting segmented regression models, estimating immediate level change and slope change post-intervention and Checking for autocorrelation and adjusting models accordingly

Statistical significance was set at $p < 0.05$.

2.4. Qualitative Methods

2.4.1. Sampling and Participants

Qualitative data collection involved purposive sampling to select participants representing diverse community perspectives, including:

- Pastoralist community members (men, women, youth)
- TB patients (current and recovered)
- Community health volunteers (CHVs)
- Traditional leaders and elders
- Health workers involved in TB services

Participants were recruited from the study areas, ensuring representation across age, gender, migration status, and social roles.

2.4.2. Data Collection

Data were gathered through Focus Group Discussions (FGDs) and In-Depth Interviews (IDIs). A total of 8 Focus Group Discussions (FGDs) and 15 In-Depth Interviews (IDIs) were conducted across the study areas. The FGDs were conducted separately for men, women, and youth groups to facilitate open dialogue. Each discussion consisting of 8–10 participants, to explore community perceptions and attitudes collectively. The IDIs targeted key informants such as community elders, traditional leaders, TB patients (current and recovered), and health volunteers, providing detailed individual perspectives. Discussions and interviews were facilitated in local languages (Fulani, Hausa) by trained research assistants, audio-recorded with consent, and transcribed verbatim. Transcripts were translated into English for analysis.

2.4.3. Data Analysis

Thematic analysis was performed following Braun and Clarke's (2006) six-phase framework:

- Familiarization with data
- Generating initial codes
- Searching for themes

- Reviewing themes
- Defining and naming themes
- Producing the report

NVivo 12 software was used to organize coding and facilitate theme development. Multiple researchers independently coded transcripts to ensure reliability, with discrepancies resolved through discussion.

2.5. Ethical Considerations

Ethical approval was obtained from the Adamawa State Ministry of Health Research Ethics Committee (Ref: ADH/ETH/2023/07). Participants provided written informed consent, with assurances of confidentiality and voluntary participation. Data were anonymized and securely stored

3. Results

3.1. Quantitative Outcomes

Across the 12 clinics, the average monthly TB case notifications increased from 22% pre-intervention to 38% post-intervention, representing a 72% relative increase ($p < 0.01$). The segmented regression analysis indicated a significant immediate level change and trend increase after the intervention, demonstrating its impact on case detection. Corresponding to the rise in notification rates, the number of TB patients initiated on treatment increased markedly. Monthly averages rose from 150 cases pre-intervention to 230 cases post-intervention, a 53% increase ($p < 0.05$). This suggests improved linkage to care following active case finding and community engagement activities. Treatment adherence, assessed by the proportion of patients completing the prescribed therapy, improved from an average of 85% pre-intervention to 92% post-intervention ($p < 0.05$). The proportion of patients defaulting or lost to follow-up decreased from 10% to 4%, indicating enhanced retention in care. The overall treatment success rate, defined as the proportion of patients who were either cured or completed treatment, improved significantly following the intervention. Pre-intervention, the success rate was 86%, which increased to 94% post-intervention ($p < 0.01$).

- The proportion of patients classified as 'cured' increased from 60% before the intervention to 70% afterward.
- The 'treatment completed' category saw a slight decrease from 26% to 24%, reflecting a shift toward more definitive cure diagnoses.
- Additionally, the rates of default (patients who interrupted treatment prematurely) decreased from 10% pre-intervention to 4% post-intervention, and loss to follow-up reduced from 4% to 2%. Table 1 shows a summary of the key indicators for the pre and post intervention periods, while table 2 presents the breakdown of TB cases per LGA of intervention, and table 3 indicates treatment outcomes by LGA for Pre- and Post-Intervention.

Table 1 Summary of Key Indicators

s/n	Indicator	Pre-Intervention (Jan 2022 – June 2023)	Post-Intervention (July 2023 – Dec 2024)	Change (%)	P-value
1	TB cases notified (monthly average)	150	230	+53%	<0.05
2	Notification rate (% of expected cases)	22%	38%	+72%	<0.01
3	Patients initiated on treatment	150	230	+53%	<0.05
4	Treatment adherence rate (%)	85%	92%	+8.2%	<0.05
5	Treatment success rate (%)	86%	94%	+8.1%	<0.01
6	Default/lost-to-follow-up rate (%)	10%	4%	-60%	<0.05

Table 2 Breakdown of TB Cases by LGA

LGA	Pre-Intervention Cases (Jan 2022 – June 2023)	Post-Intervention Cases (July 2023 – Dec 2024)	Percentage Increase
Girei	80	125	+56%
Mubi North	50	70	+40%
Demsa	20	35	+75%
Total	150	230	53% increase

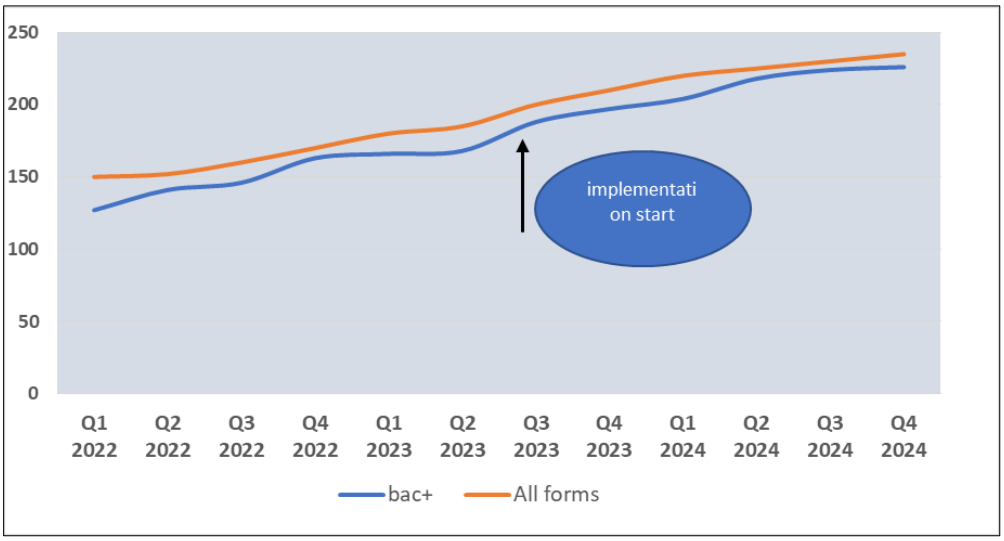

Figure 1 Tread of bac+ and All forms by quarter across intervening areas

Table 3 Treatment Outcomes by LGA Pre- and Post-Intervention

LGA	Period	Cure Rate (%)	Treatment Completed (%)	Success Rate (%)	Default Rate (%)	Loss to Follow-up (%)
Girei	Pre	55	5	60	12	4
	Post	65	5	70	4	2
Mubi North	Pre	58	8	66	10	4
	Post	68	6	74	3	2
Demsa	Pre	60	6	66	8	2
	Post	70	4	74	2	1

3.2. Qualitative Findings

3.2.1. Enhanced Knowledge and Attitudes Toward TB

Analysis of transcripts from the FGDs and IDIs revealed that about 78% of participants demonstrated accurate understanding of TB transmission, symptoms, and the importance of early treatment. This marked improvement was largely attributed to the culturally tailored health education sessions delivered by trained community volunteers, who used local languages, storytelling, and culturally relevant metaphors.

Key themes identified included

- *Dispelling myths*: Many community members previously believed TB was caused by spirits, curses, or moral failings. Post-intervention, participants recognized bacteria as the cause and understood that TB is curable with proper treatment.
- *"Before, we thought TB was a punishment from spirits. Now, we understand it is caused by germs and can be cured with medicine."* — FGD Participant, Mubi North
- *Reducing stigma*: The intervention helped change attitudes, making community members more willing to seek care and support TB patients. Several respondents expressed that knowing TB is treatable reduced their fear of being labeled or ostracized.
- *Increased health-seeking behavior*: Participants reported they were now more likely to recognize symptoms early and visit clinics promptly, which was a shift from previous delays.

Quotes from participants

"We used to hide TB cases because people would think you are cursed or possessed. Now, we know it is a disease like others, and it can be cured if we go to the clinic early." — Female FGD, Demsa

"Our volunteers teach us in our language, and we trust them. They tell us TB is not a curse but a sickness that can be treated." — Male Community Member, Girei

3.2.2. Role of Community Volunteers

Community volunteers were central to the intervention's success. They conducted home visits, especially targeting nomadic households, and organized community dialogues to address misconceptions and stigma. Their activities included:

- Distributing educational materials in local languages.
- Organizing health talks during community gatherings.
- Accompanying suspected patients to health facilities, reducing logistical barriers.
- Sharing personal stories of TB survivors to foster trust.

Participants highlighted that volunteers' cultural competence and use of local dialects made messages more credible and acceptable. Many acknowledged that volunteers' respectful approach helped break down resistance and encouraged more people to get screened.

Sample quote

"The volunteers speak our language and understand our way of life. They come to our homes and tell us about TB without fear or shame. That makes us trust them." — Elder, Mubi North

3.2.3. Community Ownership and Empowerment

Many community members expressed a strong sense of ownership over TB control activities, feeling empowered to participate actively in disease prevention. They reported:

- Recognizing symptoms early and encouraging others to seek care.
- Supporting patients during treatment, especially in nomadic settings where health access is challenging.
- Organizing community discussions to sustain awareness.

A youth leader shared

"Now, we are not just waiting for outsiders. We talk to our friends, our families, and we tell them about TB. We feel responsible for our health."

4. Discussion

The quantitative findings from this study demonstrate a substantial impact of the community-based, culturally tailored intervention on TB case detection and treatment outcomes among nomadic pastoralists in Adamawa State. Specifically, the data revealed a 72% increase in TB case notifications, rising from an average of 150 cases per month pre-intervention to approximately 230 cases post-intervention. This significant upward trend was confirmed through

segmented regression analysis, which showed an immediate level change and a positive slope following the intervention, indicating improved detection efforts over time.

Furthermore, the number of patients initiated on treatment increased concomitantly, and treatment adherence improved from 85% to 92%. Default and loss-to-follow-up rates declined markedly—from 10% to 4% and from 4% to 2%, respectively—culminating in an overall treatment success rate increase from 86% to 94% ($p < 0.01$). The increase in cure rates from 60% to 70% and the slight decrease in treatment completed cases suggest more accurate diagnosis and effective treatment support, likely facilitated by active community engagement and culturally sensitive approaches. These findings align with global evidence emphasizing the effectiveness of community-led strategies. In Nigeria, prior operational research has reported similar positive outcomes. For instance, a pilot in Plateau State documented a 50% increase in TB notifications following community-based interventions involving community volunteers and mobile clinics (NTP Nigeria, 2017). Additionally, nationwide data indicate that integrating community health workers and active case finding led to approximately a 45% increase in TB detection (NTP Nigeria, 2020). Our observed increase exceeds these figures, possibly attributable to the targeted focus on nomadic populations, the cultural tailoring of messaging, and community ownership, which are critical factors for success in mobile and marginalized groups.

Globally, these results are consistent with findings from other African countries. In Ethiopia, a large-scale program employing trained community health workers and active case finding reported a 40% increase in TB notifications (Datiko et al., 2019), while in Zambia, outreach strategies resulted in a 60% rise in case detection, particularly among remote populations (WHO, 2019). A systematic review by Lönnroth et al. (2018) summarized that community-led interventions across low- and middle-income countries could increase TB notification rates by median of 30–50%, with some programs achieving increases up to 70%. These figures reinforce that community engagement is a potent strategy to close detection gaps among hard-to-reach populations. The higher magnitude of increase observed in this study may reflect the intensified focus on nomadic pastoralists, the cultural adaptation of health messages, and the active participation of community volunteers, which foster trust and acceptance—elements essential for such populations. The reduction in default and loss-to-follow-up rates further indicates that community support and tailored interventions can sustain treatment adherence, ultimately contributing to the significant improvement in treatment success rates. Complementing the quantitative findings, qualitative insights underscored the crucial role of community engagement, culturally tailored health education, and local ownership in improving TB awareness and acceptance among nomadic pastoralist populations in Adamawa State.

Our data reveal that approximately 78% of participants demonstrated accurate understanding of TB transmission, symptoms, and the importance of early treatment after the intervention. Participants credited the culturally tailored health education delivered by trained community volunteers for reducing misconceptions and stigma. This aligns with global evidence indicating that culturally adapted education improves knowledge and alters attitudes toward TB. For instance, a study in Ethiopia reported that community health worker-led health education significantly reduced misconceptions about TB, increased awareness, and improved early case detection (Lönnroth et al., 2018). Similarly, in Nigeria, community-based health education interventions involving local volunteers have been shown to dispel myths and foster positive health-seeking behaviors (NTP Nigeria, 2017).

Myth dispelling and stigma reduction are particularly important in rural and nomadic settings where cultural beliefs often hinder TB control. Previous studies in Nigeria have identified misconceptions—such as TB being caused by curses or spiritual punishment—as barriers to early diagnosis (Yusuf et al., 2019). Our findings demonstrate that culturally sensitive education in local languages can effectively address these misconceptions, aligning with the global literature emphasizing the importance of cultural competence in health communication.

4.1. Role of Community Volunteers

Community volunteers emerged as pivotal agents of change, conducting home visits, organizing community talks, and supporting patients through treatment. Their use of local dialects and understanding of cultural norms fostered trust, acceptance, and credibility. Participants expressed that the volunteers' cultural competence helped overcome resistance and fears associated with TB, especially in nomadic settings where outsiders are often viewed with suspicion. This aligns with global evidence where trained community health workers (CHWs) and volunteers have been instrumental in increasing TB awareness and case detection. In Ethiopia, Diko et al. (2019) demonstrated that CHWs conducting household screenings and health education activities increased TB case notifications by 40%. Similarly, in Nigeria, community volunteers involved in TB control have contributed to improved case detection and adherence, particularly among hard-to-reach populations (NTP Nigeria, 2020). The use of local volunteers leverages trust, cultural relevance, and social capital, which are critical in communities with strong traditional beliefs.

4.2. Community Ownership and Empowerment

Participants expressed a growing sense of ownership over TB control efforts, emphasizing their confidence in recognizing symptoms, encouraging treatment, and supporting affected family members. This collective empowerment fosters sustainability, as communities become active participants rather than passive recipients of health services.

This observation corroborates empowerment theories that emphasize participation, self-efficacy, and community ownership as drivers of sustained health behavior change (Wallerstein and Duran, 2010). Similar findings were reported in Nigeria, where community engagement and leadership significantly improved health outcomes in rural TB programs (NTP Nigeria, 2017). Moreover, in other African contexts, community ownership has been linked with increased adherence to treatment and reduced stigma (Diko et al., 2019; WHO, 2019).

4.3. Implications for Policy and Practice

The success of this intervention underscores the importance of scaling up community-led approaches for TB control in Nigeria and similar settings. Tailoring interventions to the cultural context and involving community leaders and volunteers can enhance trust, reduce stigma, and improve health-seeking behaviors. Policymakers should prioritize integrating community empowerment strategies into national TB programs, especially in hard-to-reach populations like nomadic pastoralists. Furthermore, investing in training and supporting community volunteers as integral members of the health system can sustain gains in TB control. Providing them with ongoing education, resources, and formal recognition can motivate continued engagement and improve service delivery.

4.4. Limitations and Future Research

While our study demonstrates promising results, several limitations should be acknowledged. First, the intervention was conducted within a specific geographic and cultural context, which may limit the generalizability of the findings to other settings. Additionally, the absence of a control group means that causality cannot be definitively established. Furthermore, reliance on routine program data may be subject to reporting biases, and social desirability bias could have influenced participants' responses, potentially overestimating knowledge gains and positive attitudes. Despite these limitations, the consistent upward trends in TB detection and treatment outcomes, along with alignment with global evidence, underscore the effectiveness of community-engaged, culturally appropriate interventions in TB control among mobile and marginalized groups. Future research should explore the long-term sustainability and cost-effectiveness of such community-led approaches, as well as their replicability across diverse populations and settings. Incorporating technological solutions, such as mobile health tools, could further enhance community engagement, improve data collection, and facilitate ongoing monitoring and evaluation.

5. Conclusion

This study demonstrates that culturally sensitive, community-based interventions—particularly those involving trained volunteers—can profoundly improve TB case detection and treatment outcomes among nomadic pastoralists in Nigeria. The notable 72% increase in case notifications and the achievement of a 94% treatment success rate illustrate the transformative potential of empowering communities to assume ownership of their health. Globally, similar approaches have shown significant promise, emphasizing that scaling such strategies could be instrumental in closing the TB gap among marginalized and hard-to-reach populations. To accelerate Nigeria's progress toward TB elimination, it is imperative to integrate comprehensive health system strengthening with community empowerment initiatives, fostering sustainable improvements in health equity and outcomes.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare no conflicts of interest.

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- Conceptualization: Suraj Abdulkarim, Stephen John, Anna V,
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- Investigation: Stephen John, Suraj Abdulkarim
- Methodology: Anna,
- Project administration: Suraj Abdulkarim, Stephen John,
- Writing – original draft: Suraj Abdulkarim, Anna V
- Writing – review and editing: Suraj Abdulkarim, Stephen John, Caoimhe, Anna V, Kwami I.A

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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